

ACADEMIC REGULATIONS COURSE STRUCTURE AND DETAILED SYLLABUS

ELECTRICAL AND ELECTRONICS ENGINEERING
for

M.Tech. – Power Electronics & Drives
(Applicable from 2023-2024 Batches)



UNIVERSITY COLLEGE OF ENGINEERING KAKINADA (Autonomous)
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA - 533 003, ANDHRA PRADESH, INDIA

Vision and Mission of the Institute:

Vision:

To be a premier institute of excellence developing highly talented holistic human capital that contributes to the nation through leadership in technology and innovation through engineering education.

Mission:

1. To impart Personnel Skills and Ethical Values for Sustainable Development of the Nation.
2. To create Research & Industry oriented centers of excellence in all engineering disciplines.
3. To be a renowned IPR generator and repository for innovative technologies.
4. To develop Research and Industry oriented technical talent.
5. To benchmark globally the academic & research output.

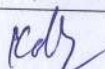
Vision and Mission of the Department

Vision:

To be in the forefront in education for meeting the needs of academic, research and industry in the areas of Electrical & Electronics Engineering, and make the department a centre of academic excellence.

Mission:

1. To provide the requisite theoretical and practical knowledge by offering appropriate courses.
2. To promote research oriented innovation culture among the students.
3. To create social awareness and ethical values in the graduates for betterment of the society.
4. To help the students in building professional capabilities in Electrical & Electronics Engineering.

Dr. M.Ramalinga Raju (Member)	Dr. Ch. Sai Babu (Member)	Dr. K. Venkata Reddy (Member)	Sri B. Naresh (Member)	Dr. K. Siva Kumar (Member)
			Attended online	Online
Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

M.Tech

Program Educational Objectives (PEOs) – Program Educational Objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve

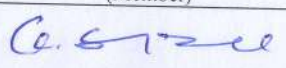
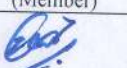
Departments needs to include PEOs (Three to Five)

Program Educational Objectives (PEO's):

PEO1	Build a self-learning capability to deal with constantly evolving tools and technology and work effectively throughout their career.
PEO2	Utilize the concepts of Power Electronics & Drive systems to develop environment friendly & sustainable technologies.
PEO3	Impart professional knowledge in the field of Power Electronics & Drives and its applications in power sectors and core industries.

Mapping of PEOs with Mission statements

	PEO1	PEO2	PEO3
M1	3	2	2
M2	2	3	3
M3	1	2	1

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Dr. V.T. Soma Sekhar (Member) Online	Dr. Viswandhan (Member) Online	Sri S. Karunakar (member) Online	Sri D.S.G. Krishna (Member) Online	Dr.K.Ravindra (Chairman) 

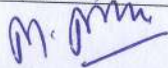
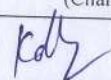
Program Outcomes (POs)

Program Outcomes (PO's):

PO1	An ability to independently carry out research /investigation and development work to solve practical problems.
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4	An ability to analyze, design and apply control methodologies for digital control of power converters and drives.
PO5	An ability to select power electronic converters for drives and power system applications.

Mapping of Program Outcomes to PEOs

	PEO1	PEO2	PEO3
PO1	3	3	3
PO2	2	1	1
PO3	3	3	3
PO4	3	2	3
PO5	2	2	3

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Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
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M.Tech Program Course Structure & Syllabus

COURSE STRUCTURE

I-SEMESTER

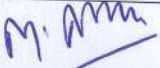
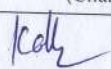
S.No	Course Code	Courses	Category	L	T	P	C
1	Program Core-1:						
	MT-PED-1101	Analysis of Power Electronic Converters Power Converters Simulation Lab	PC	3	0	3	4.5
2	Program Core-2:						
	MT- PED -1102	Electrical Machine Modeling and Analysis	PC	3	0	0	3
3	Program Elective-1:						
	MT- PED -1103	i. Power Electronics for Solar PV systems	PE	3	0	0	3
	MT- PED -1104	ii. Artificial Intelligence Techniques					
	MT- PED -1105	iii. Flexible AC Transmission Systems					
4	Program Elective-2:						
	MT- PED -1106	i. Embedded Controllers for Power Converters	PE	3	0	0	3
	MT- PED -1107	ii. Linear and Non-Linear Systems Theory					
	MT- PED -1108	iii. Digital Control Systems					
5	MT- PED -1109	Research Methodology and IPR	CC	2	0	0	2
6	MT- PED -1110	Laboartory-2 Power Converters Laboratory	LB	0	0	3	1.5
7	MT- PED -1111	Audit Course-1*	AC	2	0	0	0
Total Credits							17

*Student has to choose any one audit course listed below.

M.Tech. II-Semester

S.No	Course Code	Courses	Category	L	T	P	C
1	Program Core-3:						
	MT- PED -1201	Power Electronic Control of Electrical Drives Electric Drives Simulation Laboratory	PC	3	0	3	4.5
2	Program Core-4:						
	MT- PED -1202	Switched Mode Power Conversion	PC	3	0	0	3
3	Program Elective-3:						
	MT- PED -1203	i. Advanced Control Techniques for Power Converters	PE	3	0	0	3
	MT- PED -1204	ii. Hybrid Electric Vehicles					
	MT- PED -1205	iii. Power Quality and Custom Power Devices					
4	Program Elective-4:						
	MT- PED -1206	i. HVDC Transmission	PE	3	0	0	3
	MT- PED -1207	ii. Energy Storage Technologies					
	MT- PED -1208	iii. Advanced Controllers for Power Converters					
5	MT- PED -1209	Laboartory-4 Electric Drives Laboratory	LB	0	0	3	1.5
6	MT- PED -1210	Mini Project with Seminar	MP	2	0	0	2
7	MT- PED -1211	Audit Course-2 *	AC	2	0	0	0
Total Credits							17

Two months Mandatory Industrial Training/Internship during summer / semester break

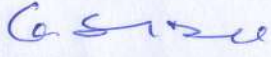
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Online	Online	Online	Online	

*Student has to choose any one audit course listed below.

Audit Course 1 & 2:

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India

6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills

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M.Tech. II SEMESTER

M.Tech. II SEMESTER							
S.No	Course Code	Courses	Cate gory	L	T	P	C
1	Program Elective-5		PE	3	0	0	3
	1. MOOCs (NPTEL) - 12 Week Course recommended by the department						
	2. Courses offered by the department in the college						
	MT- PED-2101	i. Micro Grid					
	MT- PED-2102	ii. Evolutionary Algorithms and Applications					
	MT- PED-2103	iii. Applications of Power Converters					
	Open Elective		OE	3	0	0	3
2	1. MOOCs (NPTEL/SWAYAM)-Any 12 Week Course on Engineering/ Management/ Mathematics offered by other than parent department						
	2. Courses offered to other departments in the college*						
	MT- PED-2104	i. Renewable Energy Systems					
	MT- PED-2105	ii. Concepts of IOT					
	MT- PED-2106	iii. Battery management systems and charging stations					
3	MT- PED-2104	Internship (Performed during summer / I year break)		-	-	-	2
4	MT- PED-2103	Dissertation-Part I/ Industrial Project part I#	PJ	0	0	20	10
Total Credits							18

#Students going for Industrial Project/Thesis will complete these courses through MOOCs

Chairman in consultation with the local BoS members will float the list of allowed MOOC electives, for every academic year.

* Open Elective subjects are offered to other branches by EEE Department (except for EEE Branch).

M.Tech. IV Semester

S.No	Course Code	Courses	Cate gory	L	T	P	C
1	MT- PED-2201	Dissertation-Part II/ Industrial Project part II	PJ	0	0	32	16
Total Credits							16

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Online	Online	Online	Online	

M.Tech I-Semester

COURSE CODE – MT-PED-1101	ANALYSIS OF POWER ELECTRONIC CONVERTERS	CATEGORY PC	L T P 3-0-3	credits 4.5
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Course Outcomes: After the completion of the course the student should be able to

		Knowledge Level (K)#
CO1	Illustrate the characteristics of Switching devices and use gate drive circuits. Illustrate the operation of multilevel inverters and compare their features.	3
CO2	Analyze the performance of non-isolated switch mode converters.	4
CO3	Investigate the PWM Control of single-phase and three-phase inverters and compare various PWM techniques.	4
CO4	Investigate the PWM Control of CHB and diode clamped multilevel inverters.	4

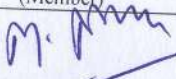
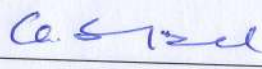
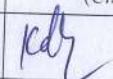
#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	1	-
CO2	2	-	2	2	3
CO3	2	-	3	2	3
CO4	2	-	3	1	2
CO5	3	-	3	2	3

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Weak)

UNIT	CONTENTS	Contact Hours
UNIT-1	Overview of Switching Devices & AC-DC converters: Power MOSFET, IGBT, GTO, GaN devices-static and dynamic characteristics, gate drive circuits for switching devices.	
UNIT-2	Non-Isolated DC-DC Converters: Control of DC-DC converters: Buck converters, Boost converters, Buck-Boost converter, CUK Converter, continuous and discontinuous operation, relation between input and output voltages, design of filter inductor and capacitors, Converter realization with non-ideal components.	
UNIT-3	PWM Inverters: Voltage control of single-phase inverters employing phase displacement Control, Bipolar PWM, Unipolar PWM. Three-phase Voltage source inverters: Six stepped VSI operation-Voltage Control of Three-Phase Inverters employing Sinusoidal PWM, Third Harmonic PWM, Space Vector Modulation- Comparison of PWM	

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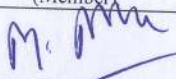
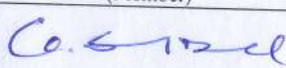
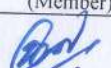
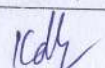
	Techniques- Three phase current source inverters.	
UNIT- 4	Multilevel Inverters: Introduction, Multilevel Concept, Types of Multilevel Inverters, Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode Clamped Inverter, Cascaded H-bridge Multilevel Inverter, Principle of Operation, Features of Cascaded H-bridge Inverter, Fault tolerant operation of CHB Inverter, Comparison of DCMLI & CHB, Modular multilevel converters, principle of operation.	
UNIT- 5	PWM Multilevel Inverters: CHB Multilevel Inverter: Stair case modulation-SHE PWM- Phase shifted Multicarrier modulation-Level shifted PWM- Diode clamped Multilevel inverter: SHE PWM-Sinusoidal PWM- Space vector PWM-Capacitor voltage balancing.	
	Total	48 Hrs

Text Books

1. Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland, William P. Robbins, John Wiley & Sons, 2nd Edition, 2003.
2. Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First Indian Reprint-2008.
3. High-power converters and AC drives -Wu, Bin, and Mehdi Narimani-John Wiley & Sons, 2017.

Reference Books:

1. Elements of Power Electronics – Philip T. Krein, Oxford University press, 2014.
2. Power Electronics Daniel W. Hart - McGraw-Hill, 2011.

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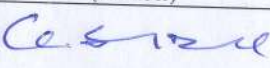
M.Tech. I-Semester

COURSE CODE – MT- PED-1101	POWER CONVERTERS SIMULATION LAB	CATEGORY LB		
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List of Experiments

Any 10 of the following experiments are to be conducted

S.No.	CONTENTS
1.	Illustrate the switching characteristics of power MOSFET and power IGBT
2.	Illustrate the use of Driver circuit for power MOSFET and power IGBT
3.	Simulation of single-phase inverter with unipolar and bipolar PWM switching.
4.	Simulation of Buck DC-DC converter.
5.	Simulation of Boost DC-DC converter.
6.	Simulation of Buck-Boost DC-DC converter.
7.	Simulation of CUK DC-DC converter.
8.	Simulation of three-phase inverter for 120° & 180° mode of conduction.
9.	Simulation of three-phase inverter for Sine-PWM method.
10.	Simulation of three-phase inverter with SVPWM method.
11.	Simulation of Sine-PWM technique for 3-phase 3-level NPC inverter.
12.	Simulation of SVPWM technique for 3-phase 3-level NPC inverter.
13.	Simulation of Stair case modulation and SHE PWM for 3-phase 5-level cascaded H-bridge inverter.
14.	Simulation of Multicarrier PWM techniques for 3-phase 5-level cascaded H-bridge inverter.
15.	Simulation of Modular Multilevel Converter.

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M.Tech. I-Semester

COURSE CODE – MT-PED-1102	ELECTRICAL MACHINE MODELING AND ANALYSIS	CATEGORY PC	L T P 3-0-0	Credits 3
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Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Develop mathematical modeling of primitive machine & model the DC machines for steady state & transient analysis.	3
CO2	Illustrate the phase/reference frame transformations and Develop mathematical modeling of three phase induction motor.	3
CO3	Interpret the knowledge of reference frame theory and obtain d-q axis modeling of induction motors in different reference frames.	3
CO4	Distinguish different inductances of a synchronous motor and obtain synchronous motor modeling in the rotor's dq0 reference frame.	4
CO5	Develop the mathematical models of special electrical machines.	3

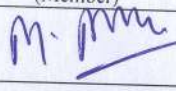
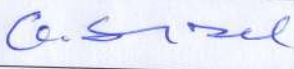
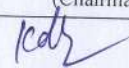
#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	2	1
CO2	1	-	2	2	1
CO3	2	-	2	2	1
CO4	2	-	2	2	1
CO5	2	-	2	2	1

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Weak)

UNIT	CONTENTS	Contact Hours
UNIT-1	Basic Concepts of Modeling & DC Machine Modeling : Basic two-pole D.C. machine - Primitive 2-axis machine – Voltage and Current relationship – Torque equation. Mathematical model of separately excited D.C. motor and D.C. Series motor in state variable form – Mathematical model of D.C. shunt motor and D.C. Compound motor in state variable form, Steady state analysis – Transient state analysis, Transfer function of the D.C. motor, Sudden application of inertia load.	
UNIT-2	Reference Frame Theory & 3-phase Induction Motor dq model: Linear transformation – Phase transformation (abc to $\alpha\beta 0$) – Power equivalence, Active transformation ($\alpha\beta 0$ to dq0), transformations in complex plane, Commonly used reference frames and transformation between reference frames, Circuit model of a 3 phase Induction motor – Flux linkage equation – dq transformation of flux linkages in the complex plane – voltage equations	

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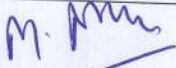
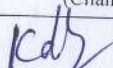
UNIT- 3	Modeling of 3-phase Induction motor in various reference frames Voltage equation transformation to a synchronous reference frame, dq model of induction motor in the stator reference frame, rotor reference frame and arbitrary reference frame, power equation, electromagnetic torque equation, state space model in induction motor with flux linkages as variables and current-flux variables	
UNIT- 4	Modeling of 3-phase Synchronous Motor Synchronous machine inductances – Circuits model of a 3-phase synchronous motor – derivation of voltage equations in the rotor's dq0 reference frame electromagnetic torque – State space model with flux linkages as variables.	
UNIT- 5	Special Machines: Modeling of Squirrel Cage Induction Machine, Modeling of DFIG, Modeling of Permanent Magnet Synchronous motor – Modeling of Brushless DC Motor, Analysis of Switch Reluctance Motors.	
Total		48 Hrs

Text Books

1. Generalized theory of Electrical Machines - Fifth edition, Khanna Publishers P. S. Bimbhra, 1985.
2. AC Motor control and electric vehicle applications – Kwang Hee Nam – CRC press, Taylor & Francis Group, 2010
3. Analysis of Electric Machinery and Drive Systems, 3rd Edition-Wiley-IEEE Press- Paul Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven Pekarek, Junr 2013.

Reference Books:

1. Electric Motor Drives - Modeling, Analysis& control - R. Krishnan- Pearson Publications- 1st edition -2002.
2. Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications - R.Krishnan , CRC Press, Year: 2001
3. Dynamic simulation of Electric machinery using Matlab / Simulink –Chee Mun Ong- Prentice Hall, 2003.

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M.Tech. I-Semester

COURSE CODE – MT- PED-1103	POWER ELECTRONICS FOR SOLAR PV SYSTEMS (PROGRAM ELECTIVE –1)	CATEGORY PE	L T P 3-0-0	Credits 3
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Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Illustrate the I-V characteristics of solar PV modules and use of blocking diodes and bypass diodes for shade mitigation	3
CO2	Use MPP techniques for extracting maximum power from PV modules	3
CO3	Illustrate the use of converters for battery charging	3
CO4	Solve leakage current problem using transformer less PV inverter topologies	4
CO5	Solve grid integration problem of PV sources	4

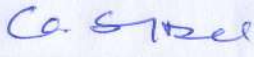
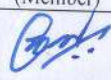
#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	1	1
CO2	2	-	3	2	2
CO3	2	-	2	2	2
CO4	3	-	3	1	3
CO5	3	-	3	3	2

(Please fill the above with Levels of Correlation, viz., L, M, H)

UNIT	CONTENTS	Contact Hours
UNIT – 1	Solar spectrum, PV materials, Equivalent Circuit for PV cell, effect of series and shunt resistance, fill factor, Cells to Modules to Arrays, I-V Curves, standard test condition, Impacts of Temperature and Insolation on I-V curves, series and parallel connection of PV modules, Shading impacts on I-V curves, Bypass diodes and Blocking diodes for shade mitigation, I-V Curves for different loads, off grid PV system with battery storage system, components in grid connected PV system.	
UNIT – 2	MPPT concept, Power extracted with resistive load, implementing variable resistance load, Maximum Power Point Tracking using DC-DC converters, Fractional open-circuit voltage, Perturb and observe method, incremental conductance method for MPPT, MPPT using PSO algorithm, distributed MPPT.	
UNIT – 3	Battery charger, Characteristics of Batteries, Charge control, Battery charging using DC-DC converter, Dual Active Bridge converter for	

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			Attended online	Online
Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
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	battery charging, PV-Powered Water Pumping system.	
UNIT – 4	Central inverters, String inverters, Micro inverters, leakage current issue, Transformer for leakage current elimination, Transformer less PV inverters: Full-Bridge Inverter, H5 Inverter, HERIC Inverter, single-phase Full-Bridge Inverter using NPC dc decoupling, Three-phase H7 inverter Topology, Three-phase inverter topology using ac decoupling and using NPC dc decoupling	
UNIT – 5	Grid connection principle, topologies for PV grid interface, Clarke's and Park's transformation, Single Stage control, Filter design, Grid synchronization & PLL, Boost converter design, Double stage control, single phase grid connection.	
	Total	

*Note:

Text Books:

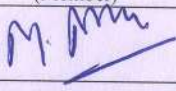
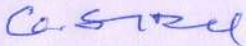
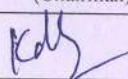
1. Renewable and Efficient Electric Power Systems, G. Masters, IEEE- John Wiley and Sons Ltd. Publishers, 2013, 2nd Edition.
2. Grid Converters for Photovoltaic and Wind Power Systems, Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Wiley, 2011, 2nd Edition.

Reference Books:

1. Solar Photovoltaic: Fundamentals, technologies & Applications, C. S. Solanki, PHI Publishers, 2019.
2. Integration of Renewable Sources of Energy, F. A. Farret, M. G. Simoes, Wiley, 2017, 2nd Edition.

Online resources:

1. https://onlinecourses.nptel.ac.in/noc22_ee71/preview

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Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

COURSE CODE – MT-PED-1104	ARTIFICIAL INTELLIGENCE TECHNIQUES (PROGRAM ELECTIVE-1)	CATEGORY PE	L-T-P 3-0-0	CREDITS 3
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Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Analyze different models of artificial neuron & Use learning methods of ANN.	4
CO2	Evaluate different paradigms of ANN.	5
CO3	Classify between classical and fuzzy sets.	4
CO4	Illustrate different modules of Fuzzy logic controller.	3
CO5	Apply Neural Networks and fuzzy logic for real-time applications.	3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	2	2
CO2	2	-	2	2	2
CO3	2	-	2	2	2
CO4	2	-	2	2	2
CO5	2	-	2	2	3

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Weak)

UNIT	CONTENTS	Contact Hours
UNIT- 1	Introduction Artificial Neural Networks (ANN) – Humans and computers – Biological neural networks – ANN Terminology – Models of Artificial neuron – activation functions –typical architectures – biases and thresholds – learning strategy(supervised, unsupervised and reinforced) learning rules, perceptron training and classification using Discrete and Continuous perceptron algorithms, ADALINE and MADLINE – linear separability and non-separability with examples.	
UNIT- 2	ANN Paradigms Generalized delta rule – Back Propagation algorithm- Radial Basis Function (RBF) network. Kohonen's self-organizing feature map (KSOFM), Learning Vector Quantization (LVQ) – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.	
UNIT- 3	Classical and Fuzzy Sets Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.	
UNIT- 4	FUZZY LOGIC CONTROLLER (FLC) Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision-making system), Defuzzification to crisp sets- Defuzzification methods.	

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Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

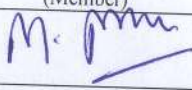
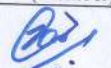
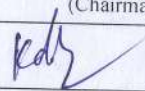
UNIT- 5	Application of AI Techniques: Selected Harmonic Elimination PWM using feed forward neural network, instantaneous current control PWM using neural network, Speed control of DC motor using Fuzzy logic, Speed control of Induction motor using Fuzzy logic.	
	Total	48 Hrs

Text Books:

1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications by Laurene Fausett, Pearson Education, 2008.
2. Introduction to Artificial Neural Systems - Jacek M. Zurada, Jaico Publishing House, 1997.
3. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.
4. Modern Power Electronics and AC Drives, Bimal K Bose, 1st Edition, Pearson Education, 2002

Reference Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharanand Pai – PHI Publication.
2. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa TMGH
3. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam, S Sumathi, S N Deepa Springer, 2007.

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Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

M.Tech. I-Semester

COURSE CODE – MT-PED-1105	FLEXIBLE AC TRANSMISSION SYSTEMS (PROGRAM ELECTIVE-1)	CATEGORY PE	L-T-P 3-0-0	CREDITS 3
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Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Know the performance improvement of transmission system with FACTS.	2
CO2	Demonstrate the effect of static shunt and series compensation.	3
CO3	Illustrate the use of SVC and STATCOM for Shunt Compensations	3
CO4	Determine an appropriate FACTS device for different types of applications.	4
CO5	Know the principle of operation and various controls of UPFC& IPFC	2

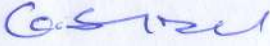
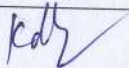
#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	-	1	-	1
CO2	2	-	2	-	2
CO3	3	-	2	2	3
CO4	3	-	2	2	3
CO5	3	-	2	2	3

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Weak)

UNIT	CONTENTS	Contact Hours
UNIT – 1	FACTS concepts, Transmission interconnections, power flow in an AC System, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers.	
UNIT – 2	Basic concept of voltage and current source converters, comparison of current source converters with voltage source converters. Static shunt compensation : Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, improvement of transient stability, Power oscillation damping, methods of controllable VAR generation, variable impedance type static VAR generation, switching converter type VAR generation, hybrid VAR generation.	
UNIT – 3	SVC and STATCOM: The regulation slope, transfer function and dynamic performance, transient stability enhancement and power oscillation damping, operating point control and summary of compensation control.	
UNIT – 4	Static series compensators: Concept of series capacitive compensation, improvement of transient stability, power oscillation damping, functional requirements. GTO thyristor controlled series capacitor	

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Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

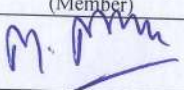
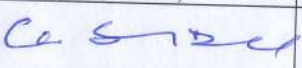
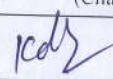
	(GSC), thyristor switched series capacitor (TSSC), and thyristor controlled series capacitor (TCSC), control schemes for GSC, TSSC and TCSC.	
UNIT – 5	Unified Power Flow Controller: Basic operating principle, conventional transmission control capabilities, independent real and reactive power flow control, comparison of the UPFC to series compensators and phase angle regulators. Introduction to Inter line Power Flow Controller (IPFC).	
Total		48 Hrs

Text Books:

1. “Understanding FACTS Devices” N.G.Hingorani and L.Guygi, IEEE Press.
Indian Edition is available:--Standard Publications

Reference Books:

1. Sang.Y.Hand John.A.T, “Flexible AC Transmission systems” IEEE Press (2006).
2. HVDC & FACTS Controllers: applications of static converters in power systems-
Vijay K.Sood- Springer publishers

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			Attended online	Online
Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

COURSE CODE – MT- PED-1106	EMBEDDED CONTROLLERS FOR POWER CONVERTERS (PROGRAM ELECTIVE-2)	CATEGORY PE	L-T-P 3 -0-0	CREDITS 3
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Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Demonstrate features of C2000 Family of Microcontrollers	3
CO2	Illustrate GPIO capabilities of C2000 Microcontrollers	3
CO3	Demonstrate different programming tools and write Embedded-C programming for accessing basic peripherals	3
CO4	Illustrate various PWM generation modules in C2000 Microcontroller and generate PWM signals	3
CO5	Demonstrate ADC and DAC operation and access voltage and current signals	3

#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	1	-	2	-	-
CO2	1	-	2	-	-
CO3	2	-	3	-	-
CO4	2	-	3	3	2
CO5	2	-	3	3	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Weak)

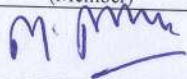
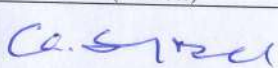
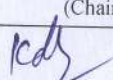
UNIT	CONTENTS	Contact Hours
UNIT – 1	Introduction to C2000 Microcontroller Architecture: Basics of Embedded System; Introduction to Real-time Microcontrollers; C2000 Family of Microcontrollers; Fixed point and Floating point processing units; Functional Block diagram & Architectures of C28x processors; Types of memory in C2000 and their mapping, Device Boot modes and operation, Power management and clocking.	
UNIT – 2	Timers, Interrupts & General Purpose Input/Output (GPIO): Introduction to CPU Timers, Resets, Interrupts – Peripheral interrupts, Exceptions, and non-maskable Interrupts; Introduction to GPIO; Configuration overview; GPIO and Peripheral muxing; Input qualification settings; Input X-bar settings; GPIO and X-bar Registers.	
UNIT – 3	C2000 Programming Development Environment: Basics of Embedded C programming; Code Composer Studio (CCS) IDE – Basic layout, settings, tools, source code editor, project build environment, debugger, profiler; Introduction to C2000Ware; Programming examples- Blink LED, GPIO Digital Input &	

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Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

	Output, Push button and Keypad interface, Timer Interrupts.	
UNIT – 4	Enhanced Pulse Width Modulation (ePWM) Peripheral: Introduction to ePWM; ePWM architecture & sub modules- Time base module, counter compare, Action qualifier, Dead-band module, PWM chopper module, Trip-zone and Event trigger module, Digital compare module; ePWM registers; Introduction to High-Resolution PWM (HRPWM); Programming examples- Fixed and variable duty PWM generation, Dead band generation, 3-phase ePWM signals generation.	
UNIT – 5	Analog to Digital (ADC) & Digital to Analog Peripherals (DAC): Introduction to ADC; SoC (Start of Conversion) Principle of operation & configurations; ADC conversion priority (Round-robin sequence); ADC registers and Interrupts; Introduction to DAC; Operation sequence; DAC registers; Programming examples- ADC start of conversion and calibration, Voltage and current sensing using ADC, ADC SoC using EPWM Compare register event, Generation of sine wave using DAC.	
Total		48 Hrs

References:

1. TMS320F28004x Real-Time Microcontrollers- Technical Reference Manual
2. Getting Started With C2000™ Real-Time Control Microcontrollers (MCUs)- Technical reference Manual
3. C2000™ Microcontroller Workshop guide Manual, Texas Instruments
https://software-dl.ti.com/trainingTTO/trainingTTO_public_sw/c28x28069/C28x_Microcontroller_MDW_5-0.pdf
4. M. Rafiqzaman, Steven A.M., “Digital logic with an Introduction to Verilog and FPGA-Based Design”, John Wiley & Sons, Inc., 2020

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Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

M.Tech. I-Semester

COURSE CODE – MT- PED-1107	LINEAR AND NON-LINEAR SYSTEMS THEORY (PROGRAM ELECTIVE - 2)	CATEGORY PE	3-0-0	3
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Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Solve the state equations of dynamic systems and formulate the different canonical forms.	3
CO2	Investigate the controllability and observability	4
CO3	Analyze various types of nonlinearities and construction of trajectories using describing functions.	3
CO4	Analyze the construction of trajectories using phase plane analysis.	3
CO5	Inspect the stability of non-linear systems by direct and indirect methods	4

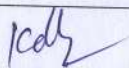
#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	1	1
CO2	2	-	2	2	2
CO3	2	-	2	2	3
CO4	2	-	2	2	2
CO5	2	-	2	3	2

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Weak)

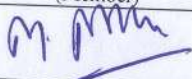
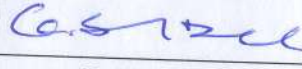
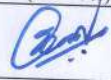
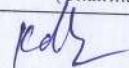
UNIT	CONTENTS	Contact Hours
UNIT- 1	State Space Analysis State space representation, solution of state equation, State Transition Matrix, Canonical forms - Controllable Canonical form, Observable canonical form, Jordan canonical form.	
UNIT- 2	Controllability and Observability Tests for controllability and observability for continuous time systems-Time varying case, minimum energy control time invariant case, Principle of Duality, controllability and observability form Jordan canonical form and other canonical forms.	
UNIT- 3	Non Linear Systems – I Introduction- Non Linear Systems, Types of Non - Linearities – Saturation,	

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			Attended online	Online
Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

	Dead, Zone, Backlash, Jump Phenomenon etc; Singular Points, Introduction to Linearization of nonlinear systems, properties of Non Linear Systems, Describing function, describing function analysis of nonlinear systems, Stability analysis of Non- Linear systems through describing functions.	
UNIT- 4	Non Linear Systems – II Introduction to phase plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase – plane analysis of nonlinear control systems.	
UNIT- 5	Stability Analysis Stability in the sense of Lyapunov, Lyapunov's stability and Lyapunov's instability theorems, Stability Analysis of the Linear Continuous time invariant systems by Lyapunov second method, Generation of Lyapunov functions – Variable gradient method, Krasooviski's method.	
	Total	48 Hrs

Text Books:

1. Ogata, K., 'Modern Control Engineering', Prentice Hall of India, 2010.
2. C.T. Chen, 'Linear Systems Theory and Design', Oxford University Press, 3rd Edition, 1999.
3. M. Vidyasagar, 'Nonlinear Systems Analysis', 2nd edition, Prentice Hall, Englewood Cliffs, New Jersey 07632.
4. Hassan K. Khalil, 'Nonlinear Systems', Pearson Educational International Inc. Upper Saddle River, 3rd Edition.

Dr. M.Ramalinga Raju (Member) 	Dr. Ch. Sai Babu (Member) 	Dr. K. Venkata Reddy (Member) 	Sri B. Naresh (Member) Attended online	Dr. K. Siva Kumar (Member) Online
Dr. V.T. Soma Sekhar (Member) Online	Dr. Viswandhan (Member) Online	Sri S. Karunakar (member) Online	Sri D.S.G. Krishna (Member) Online	Dr.K.Ravindra (Chairman) 

M.Tech. I-Semester

COURSE CODE – MT- PED-1108	DIGITAL CONTROL SYSTEMS (PROGRAM ELECTIVE - 2)	CATEGORY PE	L T P 3-0-0	Credits 3
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Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Analyze digital control systems using Z-transforms and Inverse Z-Transforms.	4
CO2	Evaluate the state transition matrix and solve state equation for discrete model for continuous time systems, investigate the controllability and observability.	5
CO3	Determine the stability.	5
CO4	Design state feedback controller.	4
CO5	Design an observer.	3

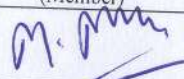
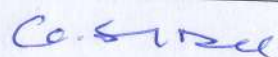
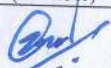
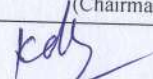
#Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	1	1
CO2	2	-	2	2	2
CO3	2	-	2	2	2
CO4	2	-	2	2	2
CO5	2	-	2	2	3

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Weak)

UNIT	CONTENTS	Contact Hours
UNIT- 1	Introduction Introduction to analog and digital control systems – Advantages of digital systems – Typical examples– Sample and hold devices – Sampling theorem and data reconstruction-Transfer functions and frequency domain characteristics of zero order hold and first order hold. Review of Z-transforms- solving differential equations. Mapping between the S-Plane and the Z-Plane – Primary strips and Complementary Strips	
UNIT- 2	State space analysis and the concepts of Controllability and observability State Space Representation of discrete time systems – State transition matrix properties and evaluation – Solution of state equations- Discretization of continuous-time state equations –controllability and observability – concepts, conditions and tests, Principle of duality.	
UNIT- 3	Stability Analysis	

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Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

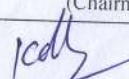
	Stability criterion – Modified Routh’s stability criterion and Jury’s stability test, Lyapunov’s stability analysis, Root locus technique in the z-plane.	
UNIT- 4	State feedback controller design Design of state feedback controller through pole placement techniques, Necessary and sufficient conditions, Ackermann’s formula, controller for deadbeat response, control system with reference input.	
UNIT- 5	State Observer Necessary and sufficient condition for state observation-Full order state observer- error dynamics – design of prediction observers- Ackermann’s formula-effect of the addition of observer on closed loop system-Current observer- minimum order observer, observed – state feedback control system with minimum order observer -control system with reference input.	
Total		48 Hrs

Text Book:

1. Discrete-Time Control systems – K. Ogata, Pearson Education/PHI, 2nd Edition.
2. B. C. Kuo, “Digital control systems”- Holt Saunder’s International Edition, 1991.

Reference Books:

1. M. Gopal: Digital control engineering, New Age Int. Ltd., India, 1998.
2. K. Ogata, “Modern control engineering”- PHI, 1991.

Dr. M.Ramalinga Raju (Member)	Dr. Ch. Sai Babu (Member)	Dr. K. Venkata Reddy (Member)	Sri B. Naresh (Member)	Dr. K. Siva Kumar (Member)
			Attended online	Online
Dr. V.T. Soma Sekhar (Member)	Dr. Viswandhan (Member)	Sri S. Karunakar (member)	Sri D.S.G. Krishna (Member)	Dr.K.Ravindra (Chairman)
Online	Online	Online	Online	

M.Tech. I-Semester

COURSE CODE – MT-PED-1110	POWER CONVERTERS LABORATORY	CATEGORY LB	3-0-0	1.5
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Course Outcomes: At the end of the course, student will be able to

		Knowledge Level (K)#
CO1	Illustrate the working of single and three-phase full converters and semi-converters	3
CO2	Analyze the performance of Square-wave inverters and PWM inverters	4
CO3	Analyze the performance of DC-DC converters	4
CO4	Analyze the performance of Three level NPC and Five level CHB inverters	4

Based on suggested Revised BTL

Mapping of course outcomes with program outcomes

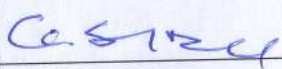
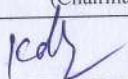
	PO1	PO2	PO3	PO4	PO5
CO1	1	2	2	-	-
CO2	2	2	3	2	3
CO3	2	2	2	-	3
CO4	2	2	3	2	3

(Please fill the above with Levels of Correlation, viz., 3: Strong, 2: Moderate, 1: Weak)

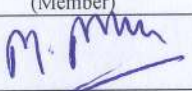
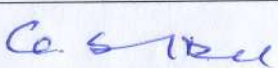
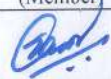
List of Experiments

Any 10 of the following experiments are to be conducted

S.No.	CONTENTS
1.	Analysis of single-phase half controlled bridge rectifier
2.	Analysis of three-phase diode bridge rectifier.
3.	Analysis of single-phase square wave inverter.
4.	Analysis of three-phase inverter for 120° & 180° mode of conduction.
5.	Analysis of three-phase inverter for Sine-PWM method.
6.	Analysis of three-phase inverter with SVPWM method.
7.	Analysis of Buck DC-DC converter.
8.	Analysis of Boost DC-DC converter.
9.	Analysis of Buck-Boost DC-DC converter.
10.	Analysis of 3-level NPC inverter.

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Online	Online	Online	Online	

11.	Analysis of 5-level cascaded H-bridge inverter.
12.	Analysis of single-phase inverter with unipolar and bipolar PWM switching.
13.	Single PV module I-V and P-V characteristics with radiation and temperature changing effect.
14.	I-V and P-V characteristics with series and parallel combination of modules.
15.	Effect of shading on PV Module.
16.	Maximum Power Point tracking of PV module using INC Algorithm.
17.	Maximum Power Point tracking of PV module using P & O Algorithm.
18.	Grid integration of solar PV systems

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